ELECTRICAL FAULT DETECTION IN PERMANENT MAGNET SYNCHRONOUS MOTOR USING ARTIFICIAL NEURAL NETWORK

Kavitha.K.C[1], Saranya.M[2], Shanmugi.S[3], Saridha.K[4],Shibiya.R[5]

Assistant Professor[1],UG Scholars[2],[3],[4],[5] ,Electrical and Electronics Engineering

Bharathiyar Institute Of Engineering For Women.

ABSTRACT

Simulation research results of PMSM drive with open phase fault detection are presented. Proposed fault detection system is implemented using two artificial neural networks. One of them is neural model of healthy PMSM and another one generates diagnostic signals. When the fault occurs, the amplitude of current residuals increases and evaluation system returns diagnosis. In proposed system detection time is about 1ms. Moreover, diagnosis does not depend on load state.

INTRODUCTION:

A fault is defined as "an unpermitted deviation of at least one characteristic property of a variable from an acceptable behavior". Faults in a system may lead to degraded performance, malfunctions, or failures. Different from fault, the consequences of a failure are usually more serious, such as partial or complete system breakdown. Faults in engineering systems are difficult to avoid. In complex systems, any fault possesses the potential to impact the entire system‟s behavior. In a manufacturing process, a simple fault may result in off specification products, higher operation costs, shutdown of production lines, and environmental damage, etc. In a continuously operated system, ignoring a small fault can lead to disastrous consequences.

In order to avoid such situation, there has been an increase in the number of fault detection techniques that are generic in nature. There are basically two generic ways to approach the analytical fault detection problem: The model based approach and the data-based approach. In the model-based approach, the engineer has access to a model of the system whose behavior is being monitored. The model could be analytical, or knowledge-based. Most applications of this approach have dealt with linear systems, since they can be easily described and studied. In the data-based approach one bypasses the step of obtaining a mathematical model and deals directly with the data. This is more appealing when the process being monitored is not known to be linear or when it is too complicated to be extracted from the data. It is conceivable that a neural net can be used as a monitoring device, in order to detect major changes in the operation of the system.

In this paper fault detection method based on model is connected with computational intelligence methods. The main blocks of the system are neural model of PMSM and diagnostic module. The output of the system is diagnostic signal which indicates open phase fault occurrence

EXISTING SYSTEM:

In Electrical drive system, occurrence of any fault may degrade the entire system‟s performance. Online fault detection plays a vital role in drive system to detect and rectifying the fault in drive systems used in safety critical applications. In this paper, suitable Electrical fault detection for Permanent Magnet Synchronous Motor using Artificial Neural Network is proposed. The neural network based method is highly efficient computing method and is suited to detect faults that develop gradually in a system. An appropriate selection of the feature extractor will provide the neural network with adequate significant details in the pattern set, so that the highest degree of accuracy in the neural network performance can be obtained. The discrete wavelet transform permits a systematic decomposition of a signal into its sub-band levels as a preprocessing of the system. Since different faults have different effects for stator currents, the wavelet transform can extract the features efficiently. The proposed approach deals with the fault detection system incorporating a neural network which is trained using Levenberg-Marquart algorithm and a Discrete Wavelet Transform based feature extraction block for Permanent magnet synchronous motor drive system.

DRAWBACK:

The main drawbacks of discrete wavelet transform are for fine analysis it becomes computationally intensive, its discretization the discrete wavelet transform (comp. efficient) is less efficient and it takes some energy to invest in wavelets to become able to choose the proper ones for a specific purpose, and to implement it correctly.

PROPOSED SYSTEM

Proposed fault detection system is implemented using two artificial neural networks. One of them is neural model of healthy PMSM and another one generates diagnostic signals. When the fault occurs, the amplitude of current residuals increases and evaluation system returns diagnosis.

ADVANTAGES

Proposed detection system is fast detection time is about 1 ms. Short time of fault detection allows to enable diagnostic signal before eventual drive damage, which may occur due to high torque pulsation during open phase state. ANN is nonlinear model that is easy to use and understand compared to statistical methods. ANN is non-parametric model while most of statistical methods are parametric model that need.

BLOCK DIAGRAM

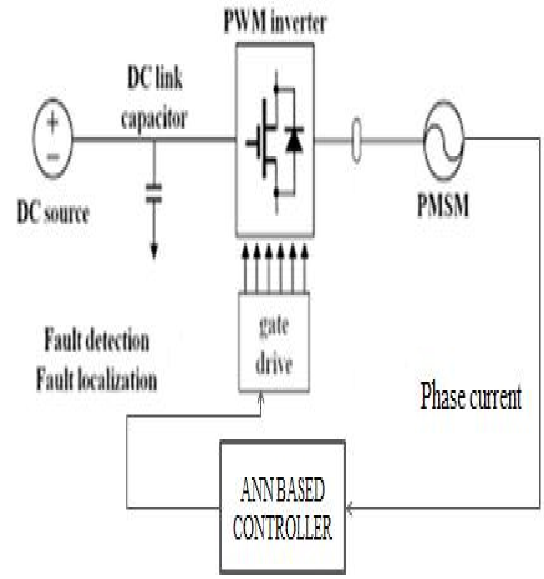

Figure.1 Block diagram of Electrical Fault Detection in Permanent Magnet

DC source gives supply to the entire system. The DC link capacitor is used to smoothening the supply voltage. The PWM inverter converts the DC supply to AC supply which is used to run the permanent magnet synchronous motor. The phase current from the motor is used to analyze the motor‟s quality using ANN based controller. ANN based controller has been implemented using two artificial neural networks. One of them is neural model of healthy PMSM and another one generates diagnostic signals. When the fault occurs, the amplitude of current residuals increases and evaluation system returns diagnosis.

When the diagnostic signal exists the gate drive starts to adjust by itself and gives the automatic corrective signal for the correct working of permanent magnet synchronous motor.

ARTIFICIAL NEURAL NETWORK

Artificial Neural Networks (ANNs) are relatively crude electronic models based on the neural structure of the brain. The brain learns from experience. Artificial neural networks try to mimic the functioning of brain. Even simple animal brains are capable of functions that are currently impossible for computers. Computers do the things well, but they have trouble recognizing even simple patterns.

The brain stores information as patterns. Some of these patterns are very complicated and allow us the ability to recognize individual faces from many different angles. This process of storing information as patterns, utilizing those patterns, and then solving the problems encompasses a new field in computing, which does not utilize traditional programming but involves the creation of massively parallel networks and the training of those networks to solve specific problems. The exact workings of the human brain are still a mystery, yet some aspects are known. The most basic element of the human brain is a specific type of cell, called „neuron". These neurons provide the abilities to remember, think, and apply previous experiences to our every action. They are about 100 billion in number and each of these neurons connects itself with about 200,000 other neurons, although 1,000 to 10,000 are typical. The power of the human mind comes from the sheer numbers of these basic components and the multiple connections between them. It also comes from genetic programming and learning.

The individual neurons are complicated. They have a myriad of parts, sub-systems and control mechanisms. They convey information via a host of electrochemical pathways. Together, these neurons and their connections form a process, which is not binary, not stable, and not synchronous.

OPERATION:

The transformer is used to give supply to the entire system. A Pair of diode provided next to the transformer is used to rectify the supply from the transformer to DC. The capacitor is used to filter ripples from the DC supply. The PIC microcontroller trained with artificial intelligence technology gives supply to the inverter then in turn drives the permanent magnet synchronous motor. Then, a feedback is provided from the motor to the inverter using current transformer and gate drive. The current transformer is used to monitor current from the motor. Whenever fault found in the current the gate drive starts to adjust itself and give the corresponding supply to the motor.

TRAINING OF ARTIFICIAL NEURAL NETWORKS

Once a network has been structured for a particular application, it is ready for training. At the beginning, the initial weights are chosen randomly and then the training or learning begins.

i) SUPERVISED TRAINING

In supervised training, both the inputs and the outputs are provided. The network then processes the inputs and compares its resulting outputs against the desired outputs. Errors are then propagated back through the system, causing the system to adjust the weights, which control the network. This process occurs over and over as the weights are continually tweaked. The set of data, which enables the training, is called the "training set." During the training of a network, the same set of data is processed many times, as the connection weights are ever refined.

Sometimes a network may never learn. This could be because the input data does not contain the specific information from which the desired output is derived. Networks also don't converge if there is not enough data to enable complete learning. Ideally, there should be enough data so that part of the data can be held back as a test.

Many layered networks with multiple nodes are capable of memorizing data. To monitor the network to determine if the system is simply memorizing its data in some non-significant way, supervised training needs to hold back a set of data to be used to test the system after it has undergone its training.

If a network simply can't solve the problem, the designer then has to review the input and outputs, the number of layers, the number of elements per layer, the connections between the layers, the summation, transfer, and training functions, and even the initial weights themselves. Another part of the designer's creativity governs the rules of training. There are many laws (algorithms) used to implement the adaptive feedback required to adjust the weights during training. The most common technique is known as back-propagation.

The training is not just a technique, but a conscious analysis, to insure that the network is not over trained. Initially, an artificial neural network configures itself with the general statistical trends of the data. Later, it continues to „learn" about other aspects of the data, which may be spurious from a general viewpoint.

When finally the system has been correctly trained and no further learning is needed, the weights can, if desired, be „frozen". In some systems, this finalized network is then turned into hardware so that it can be fast. Other systems don't lock themselves in but continue to learn while in production use.

ii) UNSUPERVISED OR ADAPTIVE TRAINING

The other type is the unsupervised training (learning). In this type, the network is provided with inputs but not with desired outputs. The system itself must then decide what features it will use to group the input data. This is often referred to as self-organization or adaption. These networks use no external influences to adjust their weights. Instead, they internally monitor their performance.

These networks look for regularities or trends in the input signals, and makes adaptations according to the function of the network. Even without being told whether it's right or wrong, the network still must have some information about how to organize itself.

This information is built into the network topology and learning rules. An unsupervised learning algorithm might emphasize cooperation among clusters of processing elements. In such a scheme, the clusters would work together. If some external input activated any node in the cluster, the cluster's activity as a whole could be increased. Likewise, if external input to nodes in the cluster was decreased, that could have an inhibitory effect on the entire cluster.

Competition between processing elements could also form a basis for learning. Training of competitive clusters could amplify the responses of specific groups to specific stimuli. As such, it would associate those groups with each other and with a specific appropriate response. Normally, when competition for learning is in effect, only the weights belonging to the winning processing element will be updated. Presently, the unsupervised learning is not well understood and there continues to be a lot of research in this aspect.

CONCLUSION:

In this paper, over current fault detection system has been proposed.The Presented method has snubber circuit, which protects the circuit from over current and over voltage. The Proposed detection system is fast – detection time is about 1 ms. Short time of fault detection allows to enable TDL algorithm before eventual drive damage, which may occur due to high torque pulsation during open phase state. Present system processes variables which are already used by vector control algorithm, avoiding the use of extra sensors. Moreover, transient states of drive system and motor speed do not influence.

REFERENCE:

1. LI LIU "Robust Fault Detection And Diagnosis For Permanent Magnet Synchronous Motors" Dissertation submitted to the Department of Mechanical Engineering, The Florida State University, College Of Engineering June 9th, 2006, pp 2-12.

2. Levenberg K., A Method for the Solution of Certain Non-Linear Problems in Least Squares. Quarterly of Applied Mathematics 2, pp.164–168, 1944. [11] Marquardt D., An Algorithm for Least-Squares Estimation of Nonlinear Parameters. SIAM Journal on Applied Mathematics 11 (2), pp. 431–441, 1963.

3. Quang N.P., Dittrich J.-A., Vector Control of ThreePhase AC Machines, Springer, Berlin 2008.